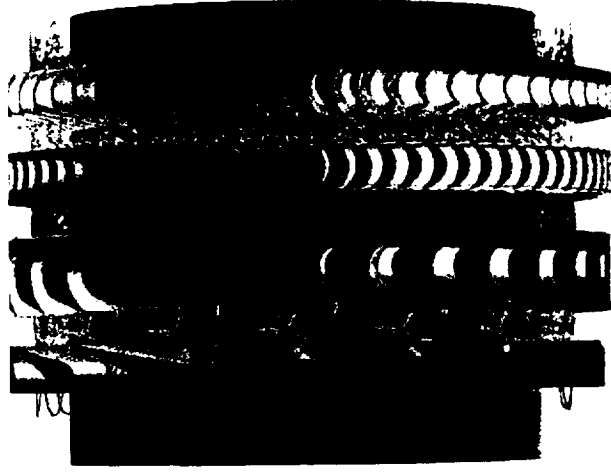




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# **Pre- and Post-Processing Tools to Streamline the CFD Process**



**Suzanne Miller Dorney, PhD  
Applied Fluid Dynamics Analysis Group  
NASA Marshall Space Flight Center  
MSFC, AL 35812**

**September 10, 2001**

# Support of CFD

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- Pre-processing
- Interim-processing
- Post-processing

# CFD Codes

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- **FDNS**
  - general purpose CFD code
  - combustion, pump, and external flow simulations
- **CORSAIR**
  - code for unsteady turbomachinery simulations
  - turbines, compressors, and internal flow simulations

# Pre-Processing Support for FDNS

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## – Geometry specification

- generated by GridGen
- obtained by another source
- standard plot3d format

## – Boundary condition specification

- generated by GridGen
- generated by hand

# FDNS Boundary Conditions

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# Specification of Boundary Conditions

[illegible]



# 3D 22-Grid Case

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Type	# Values Needed	Occurrences	Total Values
Grid Dimensions	3	22	66
Patched Interfaces	17	37	629
Flow Boundaries	14	51	714
Walls	12	56	672
Total Values			2081

# PreViewer

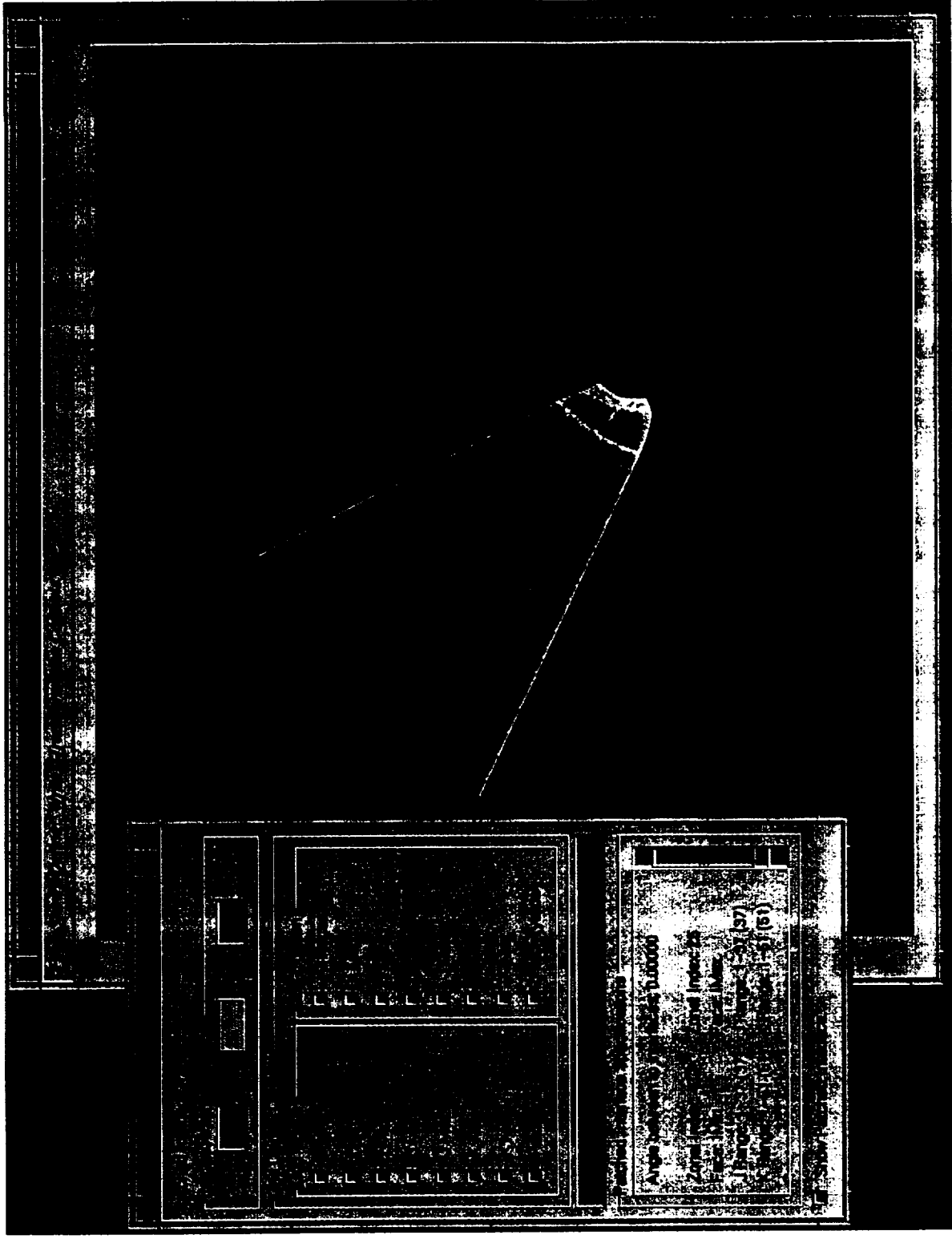
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- **Visualization tool designed specifically for FDNS**
- **Interactive tool to visually inspect input files**
- **Automated error checking of input files**

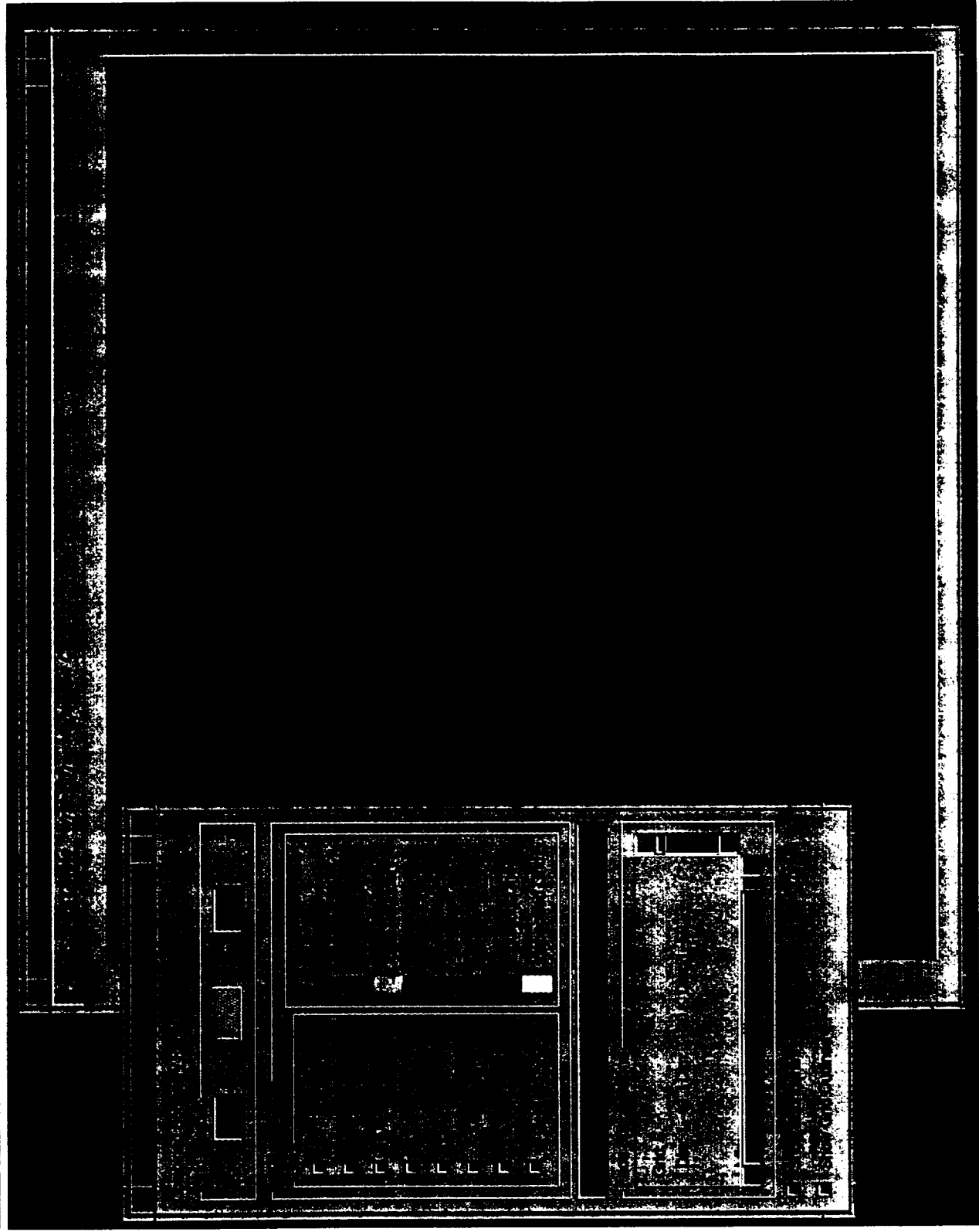


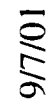
# Patched Interface Panel



9/7/01

# Combined Panel





# Future Plans for PreViewer

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- **Expand Error Checking**
- **Expand ability to define boundary conditions**
- **Set up specification files for interim- and post-processing tools**

# Interim-Processing

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- **Process**
  - generates line plots of results while the solution is forming
- **FlowShow**
  - generates an animation of contour or vector plots of solution while it is forming
- **Monitor**
  - updates screen images of mass conservation, delta, contours, vectors, and line plots of a solution while it is forming

# General Method for Interim-Processing

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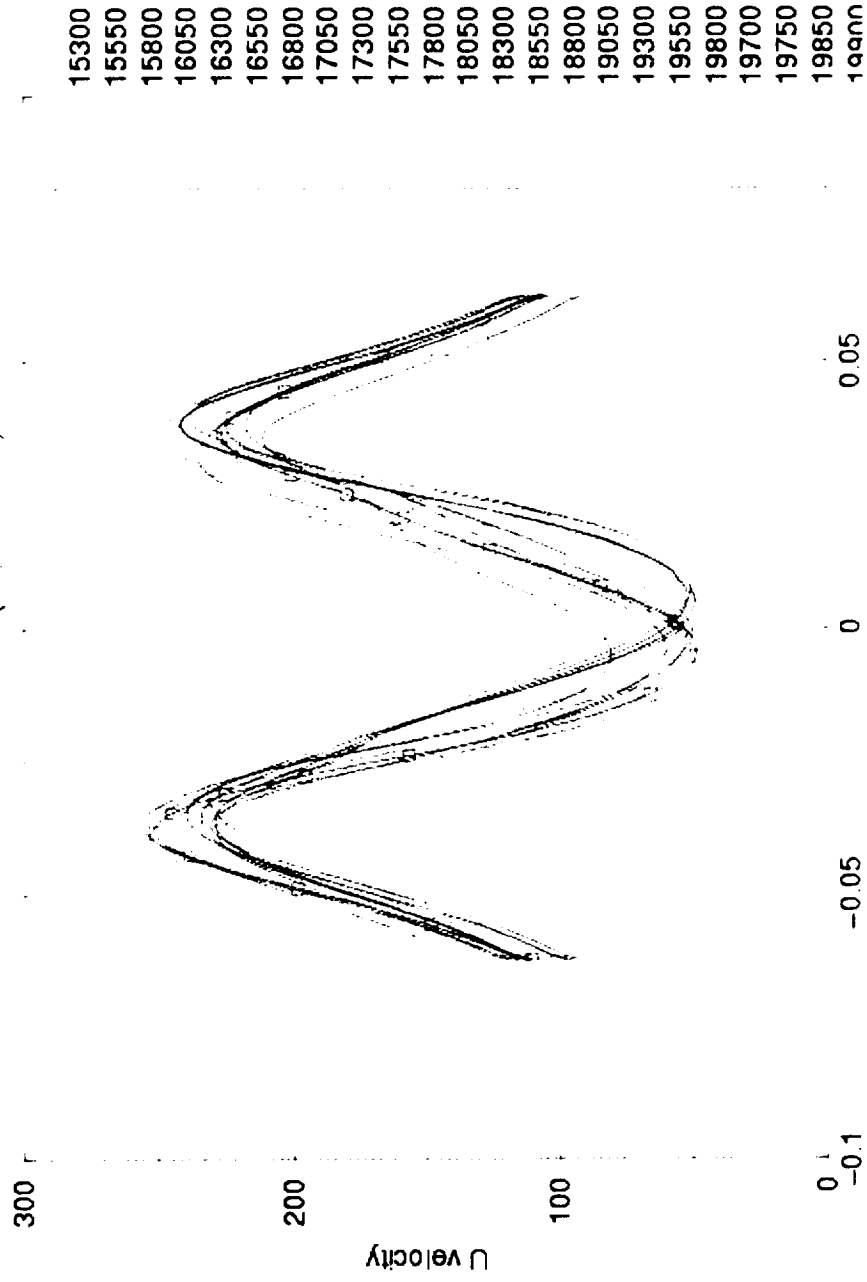
- Track a file that is being written by the flow solver during execution
- Processing is triggered each time file is updated/written
- Specified data is extracted from the file
- Line plots or images are updated, or new frames are generated

# Process: Check for Convergence



u vel vertically d/s of plumes in z6

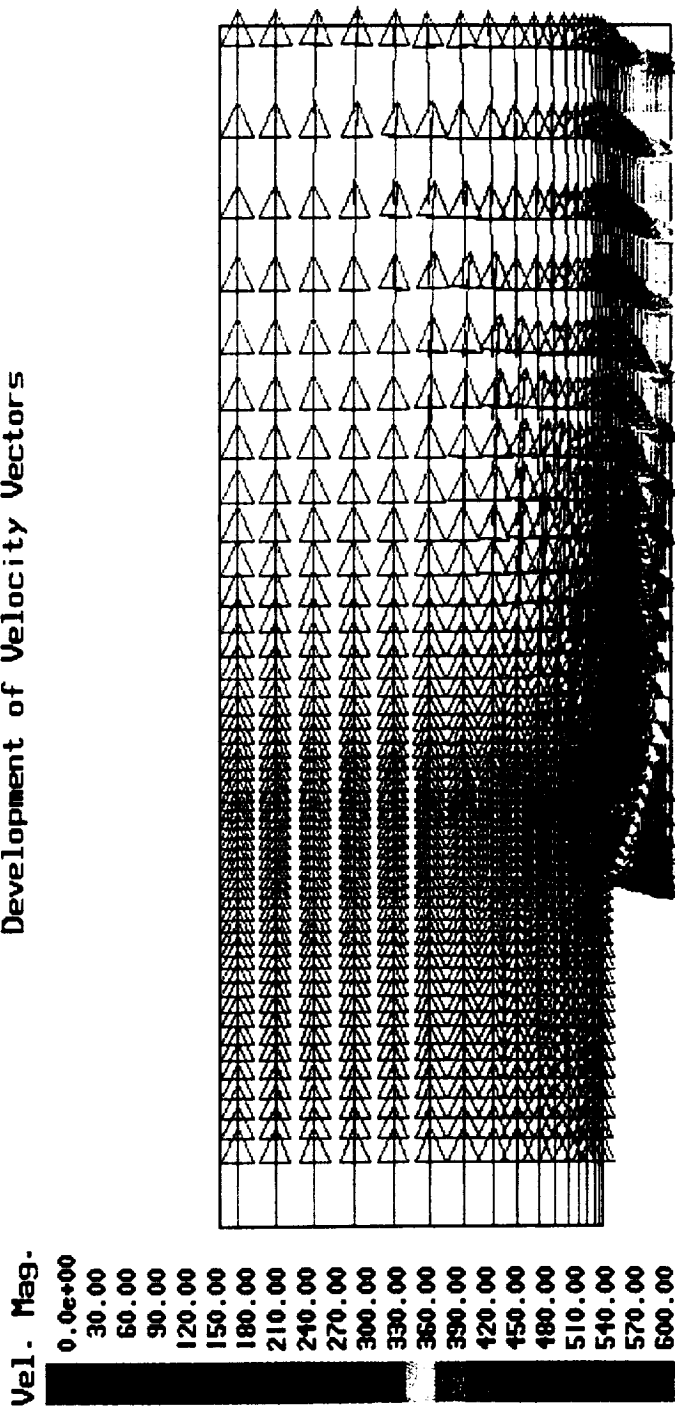
12/4/00 z6(38.2-144.15)



# FlowShow: Super-Sonic Back Facing Step



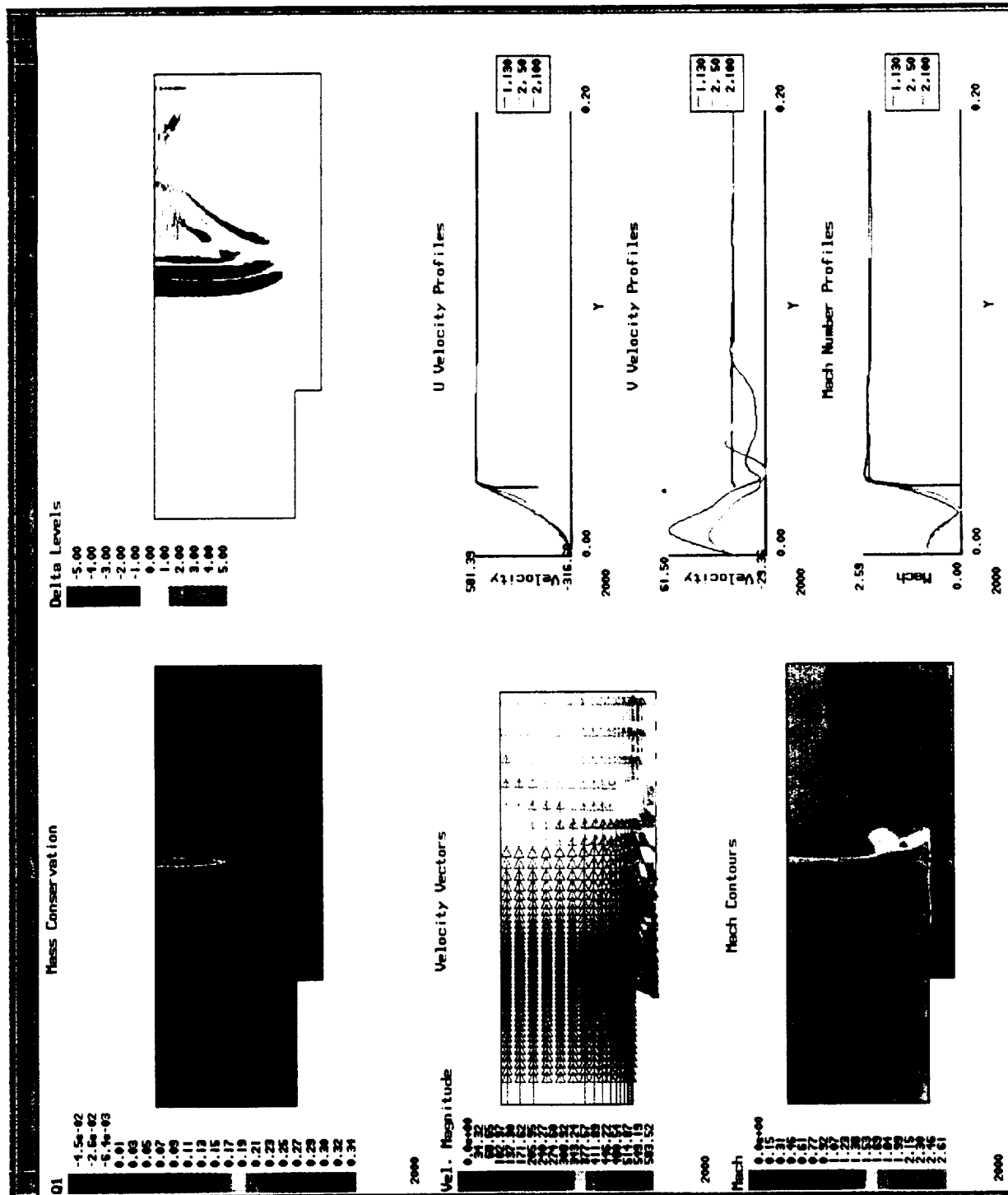
Development of Velocity Vectors



4000



# Monitor: Super-Sonic Back Facing Step



# Future Plans for Interim-Processors

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- Generate GUI's for specification of input files
- Combine functionality between tools
- Add display of experimental data

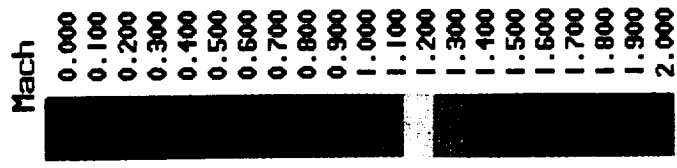
# Post-Processing

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- Plots
  - envelopes
  - contour plots
  - vector plots
  - streamline/streakline plots
- Animations
  - simple format specifications
  - runs in batch mode
  - engineer friendly

# Instantaneous Mach Contours



9/7/01

Timestep 0



Timestep 16

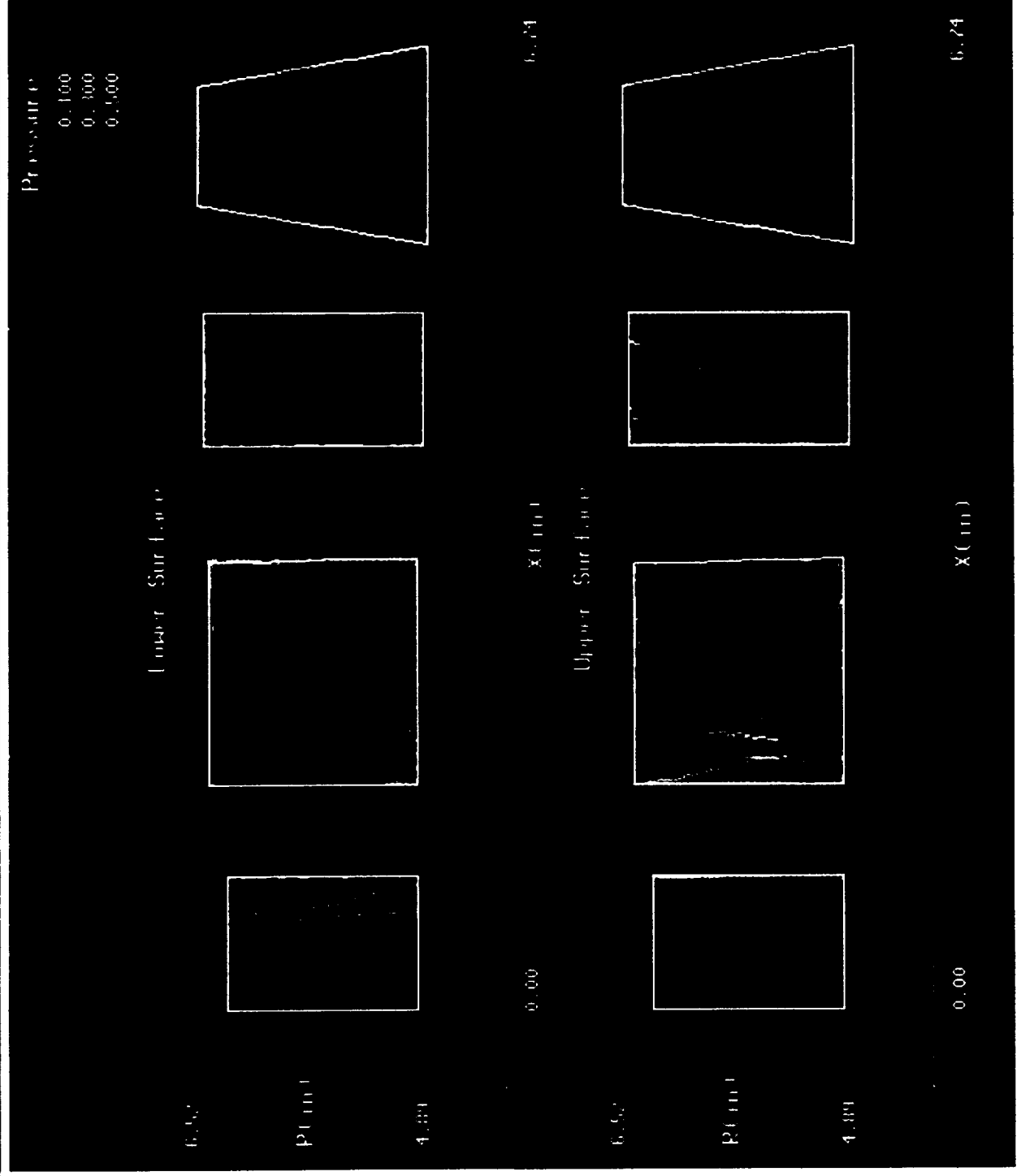
# Animator

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- **Generates MPEG animation files in batch mode**
- **Allows input files to be compressed**
- **CFD Codes**
  - CORSAIR - customized output files
  - General Codes
    - standard Plot3D files
    - xy point files
- **Types of Animations**
  - envelopes
  - line plots
  - contours
  - vectors
- **Customization of animations**

# 2-Stage Turbine Pressure Contour



# Future Plans for Animator

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- Add the calculation of streamlines/streaklines
- Include a GUI to specify the view in 3D
- Include automated feature extraction

# Conclusions

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- **Pre-Processing**
  - significantly reduced time needed for error checking
  - eliminate ambiguities in input files
- **Interim-Processing**
  - improved ability to detect convergence
  - improved understanding of underlying flow mechanisms
- **Post-Processing**
  - improved understanding of underlying flow mechanisms
  - improved technology transfer
- **Improved Designs**